POST OPERATIVE ASTIGMATISM FOLLOWING EXTRACAPSULAR CATARACT EXTRACTION AND SMALL INCISION CATARCT SURGERY – A COMPARATIVE STUDY

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CERTIFICATE

This is to certify that the dissertation entitled "**POST OPERATIVE ASTIGMATISM FOLLOWING EXTRACAPSULAR CATARACT EXTRACTION AND SMALL INCISION CATARCT SURGERY – A COMPARATIVE STUDY"** is the bonafide original work of **Dr. T. R. ANURADHA** in partial fulfillment of the requirements for **M.S. (Ophthalmology) BRANCH – III** Examination of The Tamilnadu Dr. M.G.R. Medical University to be held in March 2007.

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DECLARATION

I, **Dr. T.R. ANURADHA,** solemnly declare that dissertation titled, "**POST OPERATIVE ASTIGMATISM FOLLOWING EXTRACAPSULAR CATARACT EXTRACTION AND SMALL INCISION CATARCT SURGERY – A COMPARATIVE STUDY"** is a bonafide work done by me at Govt. Stanley Medical College & Hospital during 2004-2007 under the guidance and supervision of **Prof. Dr. A. Priya, M.S., D.O.,** Professor and Head, Department of Ophthalmology, Stanley Medical College, Chennai-600 001.

The dissertation is submitted to Tamilnadu, Dr. M.G.R. Medical University, towards partial fulfillment of requirement for the award of **M.S. Degree (BRANCH – III) in Ophthalmology.**

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CONTENTS

INTRODUCTION

Cataract is a major cause of avoidable blindness and world wide, an estimated 17 million are blind from this condition. In the absence of any preventive measure the only resource is surgery.

In the field of cataract surgery, IOL implantation after extra capsular cataract extraction was a major breakthrough. However delayed rehabilitation was the major drawback with this procedure and it produced high induced astigmatism and ocular discomfort due to sutures. Invention of phacoemulsification by "Charles Kelmann" (1965) and learning the technique of self sealing wound (1980) resolved the above mentioned problems associated with ECCE and begun the era of sutureless small incision cataract surgery.

Post operative astigmatism primarily results from the deformation of the cornea by surgery. The variables which are involved in the development of post operative astigmatism include preoperative astigmatism, location, length and configuration of the incision, suturing, suture material, intra operative and post operative manipulation.

The trend now has advanced to refractive cataract surgery which implies a coordinated attention to both spherical and astigmatic components of refraction, wherein the surgeon plans the site and length of incision based on the pre operative astigmatism of the patients.

Post operative astigmatism could be attributed to the site of incision, quality of incision, extent of incision, materials used for suturing and technique used for suturing. With the advent of finer suture materials of different sizes, various techniques of making corneoscleral section and different suturing techniques the degree and type of astigmatism can be modified.

This study is mainly concerned with the nature and amount of post operative astigmatism following ECCE using five 10-0 nylon interrupted sutures and suture less small incision cataract surgery.

AIM OF THE STUDY

- This is a study carried out to analyse post operative astigmatism between the two operative procedures-small incision cataract surgery and extracapsular cataract extraction.
- ECCE with PCIOL implantation using five 10-0 nylon interrupted sutures.
- Small incision cataract surgery with PCIOL implantation without sutures.
- This study also analyses post operative astigmatism in small incision cataract surgery group with varying length and shape of incisions.

REVIEW OF LITERATURE

MILESTONES IN THE HISTORY OF CATARACT SURGERY

600 B.C. - Couching by SUSHRUTA

865-925 A.D.- RHAZES – removed cataract with glass tube

1018 A.D. - CONSTANTINUS AFRICANUS – introduced the term "Cataract" meaning water fall

996-1020A.D- AMMAR - described suction of cataract through a needle.

1753 - JACQUES DAVIEL attempted first cataract extraction using lower limbal section with a triangular knife. He is the father of modern cataract surgery.

1753-1862 - PIERE-FRANCOIS BENEZET PAMARD shifted the surgical incision to upper part of the eye.

1753 - SAMUEL SHARP – first ICCE using thumb pressure.

1860 - VONGRAEFE– cataract knife, section in the upper limbus.

1867 - WILLIAMS – first corneoscleral suture

1895 - SMITH – ICCE using external pressure with muscle hook

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1900 - VERHOEFF - ICCE using capsule forceps

1940 - BARRAQUER – ICCE by capsule suction erysiphake

1949 - RIDLEY – ECCE with PCIOL and operating microscope

1950 - STRAMPELLI – ACIOL

1957 - BARRAQUER – ICCE by enzyme zonulolysis using α-chymotrypsin

1961 - KRAWICZ – ICCE by capsule cryo adhesion

1967 - KELMANN – ECCE by phacoemulsification

1972 - JOHNSTOCK – phaco fragmentation and irrigation system

1975 - BINKHORST – iris pupil supported IOLS

1980 - SICS Michael Blumenthal technique, vectis technique, sandwich technique

- Phaco SICS - Dr. CHARLES KELMANN

1984 - MAZZOCCO – Foldable IOLs

1985 – GIMBEL & NEUHAN – capsulorrhexis

1991 - Cataract refractive surgery

1992 - FISCHMANN – topical anaesthesia

1997 - CUMMINGS - accommodating IOL proto types

1998 – AMAR – micro phaco, phaconit- sub 2 mm phaco

2004 - 700 microns cataract surgery – micro phaconit

2004 - AKOSHI – sub 2mm with narrow sleeve, co axial micro phaco

CATARACT WOUND – HISTORICAL CONSIDERATIONS

1) AB EXTERNO INCISION:

With Vongraefe knife. This is inserted from temporal limbus, across anterior chamber and out of nasal limbus and will cut superiorly, exiting with the flap of conjunctiva still attached to superior corneal edge. This 180 degree wound was allowed to self seal with the patient's head maintained in a fixed position for a week. Later silk sutures where placed across the wound. Development of surgical microscope, fine needles and suture materials enabled the surgeon to observe the wound edges and secure them precisely. Early ambulation thus became possible.

2) SINGLE PLANE INCISION :

Straight entry incisions that directly enter the anterior chamber were introduced. Water tight closure of these incisions necessitated deep radial suture bites. These radial sutures compressed the tissue and cause flattening over the wound and steepening of the central cornea

which results in with the rule astigmatism. The patient has to wait for 6-8 weeks before receiving spectacles to achieve clear vision in order to allow time for suture induced wound distortion to fade.

3) SCLERAL TUNNEL INCISIONS :

Small posteriorly placed incisions reduces the incidence of induced with the rule astigmatism in the initial post operative period and long term against the rule astigmatism. The patient has faster visual recovery and more stable refraction and better uncorrected vision over time. Moving the incision more posteriorly and creating a longer tunnel with the bevelled entry wound into A.C enhances the valve effect of wound closure and achieves a self sealing wound.

4) CLEAR CORNEAL INCISIONS :

Clear corneal incisions are advocated for phacoemulsification. These small incisions are 2.7 – 4mm wide just enough to accommodate the phacoprobe. Usually have little or no effect on preexisting astigmatism. The deeper the vertical groove, it functions as peripheral astigmatic keratotomy incision by flattening the cornea in that meridian. It creates self sealing wound, does not require sutures and allows rapid visual rehabilitations.

SELF SEALING TUNNEL INCISIONS - MILE STONES

Dr. RICHARD KRATZ is credited as the first surgeon to move the incision from the limbus posteriorly to the sclera, increasing the appositional surfaces to enable wound healing and exert less traction on the cornea thereby controlling surgically induced astigmatism.

GIRARD and HOFFMAN were the first to call the posterior incision as " scleral tunnel incision ".

SINGER advocated the 'frown' incision and PALLIN patented the 'chevron' incision.

SHEPERD introduced the astigmatically neutral 'horizontal suture'. FINE with the 'infinity suture', MASKET with the' horizontal anchor suture', FISCHKIND with the 'horizontal overlap suture' were the modifications. These were all mattress like suture which closed the incisions without inducing traction forces.

MICHAEL MC FARLAND (1990) was the first to perform sutureless closure of the scleral tunnel wound. PAUL ERNST modified MC FARLAND 's scleral wound technique by carrying forward the tunnel into the clear cornea, thereby creating an internal corneal lip that sealed any egress of fluid from A.C. Thus began the modern day three plane incision, which incorporates a perpendicular incision through the

sclera, horizontal incision into clear cornea and an angled, bevelled incision into the anterior chamber.

FINE in February 1992 described a new concept of planar temporal clear corneal sutureless incision, which was self sealing and astigmatically neutral.

In March 1992, KELMANN described a scleral less clear corneal incision. WILLIAMSON and LANGERMAN introduced hinged clear corneal incision to improve the corneal seal. PAUL KOCH described the incision tunnel characteristic of self sealing with respect of length and configuration and astigmatic neutrality to these incisions.

KERATOMETRY – MILESTONES

The first measurement of the curvature of the anterior surface of the cornea was made by CHRISTOPHER SCHEINER (1691) who seated the object in front of a window and compared the corneal reflex with the image of the cross bars on a series of graduated marbles.

The principle of visible doubling was introduced by SERINGTON SAVERY (1753) in the heliometer. The opthalmometer was perfected by VON HELMOLTZ (1856).

In 1864, DONDERS reported against the rule astigmatism following cataract surgery. In 1869, VON REUSS and WOINOW measured astigmatism after cataract extraction with the Keratometer.

In 1900, REUTLER reported a shift to against the rule astigmatism in 88% of patients undergoing cataract surgery. In pre suture era, the amount of astigmatism against the rule was estimated to be 2-4 dioptres.

MATERIALS AND METHODS

Hundred cases of uncomplicated mature and immature cataract were selected for the study. Corneal curvature was measured with keratometer preoperatively. Extracapsular cataract extraction with PCIOL implantation was done for 50 cases and the wound was closed with 10-0 nylon, 5 interrupted sutures. Scleral tunnel with PCIOL Implantation was done for the remaining 50 patients and no suturing was done. Three types of scleral tunnel incisions – linear, frown and smile were made. All incisions were made in the upper quadrant.

Post operative evaluations included keratometry at 2 weeks, 4 weeks, 6 weeks and at 3 months. Refraction and spectacle correction was done at 6 weeks. Corneal topography was done in selected patients at 3 months.

In this study, cases which had post operative complications, fundus pathology has been deleted from the list as our main aim was to study the nature and amount of post operative astigmatism in detail.

PREOPERATIVE ASSESMENT OF THE PATIENTS

Uncomplicated mature and immature cataracts were selected with V/A ranging from perception of light to 6/36. Intraocular pressure of all patients was recorded with Shiotz tonometer. Only patients with normal

intraocular pressure were included in the study. Slit lamp examination was done in all patients to rule out any anterior segment diseases or corneal surface abnormality. Fundus examination was done in all patients to rule out fundus pathology.

Pupillary reaction was tested and patients who had brisk pupillary reaction were included in this study. Preoperative keratometry reading was recorded to assess the preoperative corneal curvature and diopteric power.

SURGICAL TECHNIQUES

FACIAL BLOCK :

Akinesia of orbicularis oculi is obtained by O'Brien's block. 2-3 ml of 2% Xylocaine is injected at the neck of the mandible.

PERIBULBAR BLOCK:

The Anaesthetic solution for peribulbar clock consists of 2% by Xylocaine with adrenaline (1: 10000) in which is dissolved 1 ml of hyaloronidase (1500 units) and 0.5 – 0.75% Bupivacaine in a ratio of 2:1.

TECHNIQUE :

Davis and Mandel were the first to describe the periconal method in 1986.

In this method, a 2.5cm. 25 or 27 gauge needle is used to inject 6-7ml of local anaesthetic solution in the periocular space. The peribulbar block is administrated by two injections , the superior injection given at the junction of the medial 1/3 and lateral 2/3 beneath the superior orbital notch with the needle directed towards the roof of the orbit. The inferior injection is given at the junction of outer 1/3 and inner 2/3 of the lower orbital rim.

INSTRUMENTS, EQUIPMENTS AND OPERATING MICROSCOPE

OPERATING MICROSCOPE :

Operating microscope enables the surgeon to do surgery under magnification with a degree of precision. With coaxial illumination, the red reflex is well made out The posterior capsule if engaged in the aspirating port, is seen as radiating lines and this should be recognized quickly to prevent posterior capsular rent. Some of the operating microscopes are zeiss, Topcon, Inami, wild, leica etc., In this study wild and leica microscope were used.

INSTRUMENTATION FOR IOL SURGERY

INSTRUMENTS USED FOR CATARCT SURGERY :

1. Barraquer lid speculum
2. Forceps - Dastoor forceps, Colibri forceps, Lim's forceps , Jaffe tying forceps
3. Scissors – Corneo scleral , Vanna's scissors

4 Bi polar cautery

4. Knife handle and Blade
5. Cystotome or 26G needle / syringes
6. Round wire vectis, snellen wire vectis, irrigating vectis, Lens expressor
7. Simcoe double barrelled irrigating aspirating cannula.
8. Mcpherson Kelman lens holding foreceps
9. Dr. Koman Nair iris repositor
10. Lens dialling hook
11. Cresent blade, entry keratome, side port, hydrodissection needle for SICS

EXTRACAPSULAR CATARACT EXTRACTION WITH PCIOL

A sterile drape is placed over the eyelids. Eyelids separation is done by eyelid retractor or lid sutures. Superior rectus suture (Saddle or Bridle suture) is useful to keep the globe retracted downwards and aids in lifting a deep set globe from the orbit. The superior rectus suture is placed by grasping the conjunctiva, tenon's fascia and the underlying superior rectus muscle with forceps 7.7mm from the limbus at 12'O clock position.

Fornix based conjunctival flap is raised. Haemostasis achieved with light bipolar cautery. Corneo scleral groove is made in the mid limbus with a diamond scalpel. Anterior chamber is entered using stab incision with knife at 12'O clock. The place of entry is parallel to mid limbus to avoid descemet's stripping or injuring the iris. Anterior chamber is reformed with viscoelastic agent, air or BSS. Capsulotomy needle is introduced into the anterior chamber, care taken no to injure endothelium are strip descemet's membrane or induce miosis while dragging the iris. Can opener's Capsulotomy is performed by making about 40 small superficial punctures in the anterior capsule. Wound is extended with corneo scleral scissors on either side to approximately 10mm.

The nucleus is delivered by means of intermittent pressure at 6'O Clock with a squint hook and constant pressure with vectis at 12'O Clock position. A 13mm long, blunt, curved 23 gauge simcoe cannula with irrigation and aspiration port of 0.3mm bore is used to aspirate the cortex. Complete cortical removal will allow the surgeon to appreciate a bright red glow. Anterior chamber is filled with viscoelastic and PCIOL is implanted in the capsular bag.

The insertion of posterior chamber IOL can be described in 3 steps.

1. Insertion of the inferior haptic behind the iris.
2. Insertion of the optic through the pupil.
3. Insertion of the superior haptic behind the iris.

The superior haptic should be rotated to 90 degrees after IOL insertion. Visco elastic substance is removed by irrigation and aspiration.

In this study single piece PMMA IOL was used and wound closure was done with 10 -0 nylon five interrupted sutures placed with deep short bites. At the conclusion of the procedure sub conjunctival injection of steroid is given, antibiotic drops applied and protective dressing is left in place or 24 hrs.

SMALL INCISION CATARACT SURGERY WITH PCIOL

ADVANTAGES OF SICS :

- Expulsive choroidal haemorrahage is less likely with this procedure. Can be managed simply by removing the instruments and closing the eye.
- An acute respiratory or cardiac incident intraoperatively can be dealt with by removing the instrument, resuscitating the patient and continuing the surgery once the patient is stable.
- Reduced incidence and severity of astigmatism and astigmatic decay. This permits early and stable post operative visual rehabilitation.
- Lower incidence of hyphaemas
- No suture induced foreign body sensation.
- Avoidance of hypotony.

COMPONENTS OF SCLERAL TUNNEL :

It has got mainly 3 components

1) External scleral incision
2) Sclero corneal incision
3) Internal corneal lip incision

This 3 step procedure leaves an internal lip of endothelium, descemets membrane and corneal stroma that seals on itself, when the

IOP returns to normal. The scleral tunnel incision has 3 dimensions a) flap thickness b) width c) depth.

Flap thickness :

The optimum incision depth may be between 1/3 – 1 /2 the thickness of sclera. A very thin flap may show a tendency to tear with manipulation and can stretch resulting in against the rule astigmatism.

Width :

Incision width is determined by the location of external wound and the internal corneal wound relative to the limbus. Incison width should be equal to incision length (square wound) and the ideal amount of dissection into clear corneal is 1.5mm.

Length :

The ultimate length of the incision determined by the overall optic size of the IOL.

PROCEDURE :

A) External scleral incision :

After raising a fornix based conjunctival flap a light cautery is applied. A perpendicular external groove is made with BP knife or Cresent knife. The length of the incision with phacoemulsification varies from 3mm with foldable IOL to 5-7 mm to introduce rigid IOL. The groove is located 2.5-3 mm from the surgical limbus and can be limbus

parallel , linear or frown shaped. The recommended depth of the groove is 1/3 – 1 /2 scleral thickness. (0.25 – 4 mm)

B) Sclero corneal tunnel :

The horizontal tunnel is dissected with a bevel up cresent blade parallel to the sclera, splitting its lamellae along its entire length. It is extended upto 1 – 1.5mm into the clear cornea.

Side port incision is placed 2 – 3 clock hours away from the tunnel site. A narrow paracentesis knife is used to make this incision parallel to iris approximately 1.5mm into clear cornea in 2mm width.

Uses of side port :

a) For making continuous curvilinear capsulorrhexis
b) 12'O clock cortex aspiration
c) Formation of AC at the end of surgery

C) Internal corneal incision :

This is created using a sharp 3.2 mm angled keratome. The heel of the kerotome is raised till the blade becomes parallel to the iris plane and the keratome tip creates a dimple on the cornea. The keratome is advanced anteriorly in the same plane till the AC is entered and the internal wound is visualized as a straight line. The incision may be extended at the conclusion of the surgery, to the desired length which is

predominantly governed by the optic size of the IOL to be inserted. This extension may be done by using the same keratome.

CAPSULOTOMY:

The first prerequisite is an adequate size capsulorrhexis which should be 5mm or more depending on the size of the nucleus.

Advantages of capsulorrhexis :

- Smooth margin, less tendency to tear
- Hydrodissection will have full potential
- Zonular stress is lesser than can opener technique.
- PCIOL centration better within the bag.
- In the presence of posterior capsular rupture, safer to place PCIOL in the sulcus.

Procedure :

The pupil should be well dialated and anterior chamber should be well maintained with viscoelastic substances. The C.C.C begins with the formation of a flap with a bent needle or a cystotome, the initial puncture should be central and a slit is created in a curved fashion eccentrically. The circular tear is started by lifting and pushing or pulling the central part of the anterior capsule. Once a tear is initiated it is easy to complete the C.C.C by needle or forceps.

TECHNIQUE OF HYDRO PROLAPSE OF THE NUCLEUS:

A good hydrodissection and hydrodelineation is a prerequisite for hydroprolapse of the nucleus. Hydrodissection is the injection of irrigating fluid between the cortex and the capsule, thereby separating the two. This procedure facilitates nuclear rotation and hydrates the peripheral cortex making it easier to aspirate. Hydrodissection should continue until the surgeon cease a wave of fluid moving across the red reflex zone. Hydrodelineation is the procedure in which BSS is injected into the substance of the nucleus to separate the various layers of the nucleus. This separates the harder endonucleus from the softer outer epinucleus.

Hydro extraction using irrigating vectis is used extensively. In phaco sandwich technique, which was invented by Luther Fry in 1985, the nucleus is delivered by sandwiching between the lens loop and lens spatula. In phaco fracture technique a broad thin and curved vectis is introduced beneath the prolapsed nucleus, a knife edged cutting spatula is placed above it and the nucleus is divided into two halves and extracted out. Epinucleus and residual cortex are removed using simcoecannula. A single piece PMMA IOL is inserted into the bag. The residual viscoelastic material is aspirated and AC is reformed through the side port incision. Wound integrity is checked by pressing against

the dome of the cornea and at the limbus. The conjunctival flap is draped over the wound and anchored by cautery. The surgery is concluded with subconjuntival injection of Gentamycin and Dexamethasone.

POST OPERATIVE MANAGEMENT AND FOLLOW-UP:

Dressing was removed on the first post operative day. Patient was treated with antibiotic steroid drops and followed up every two weeks with Keratometry and V/A testing and the magnitude of astigmatism was analysed. Fundus examination, Refraction and spectacle correction was done at six weeks.

CONCEPTS AND PRINCIPLES OF ASTIGMATISM

Post operative astigmatism results primarily from deformation of the cornea by surgery. Corneal astigmatism is a condition in which incident light rays are not refracted equally. Thus the refractive power of eye varies with the orientation of light rays in all meridians. The axis of greatest and least refractive powers can be determined which are called the principal or major meridians.

REGULAR CORNEAL ASTIGMATISM:

Astigmatism is said to be regular astigmatism when the principal or major meridians are perpendiculars to each other. Regular corneal astigmatism is of 3 types.

1. With the rule astigmatism
2. Against the rule astigmatism
3. Oblique astigmatism

With the rule astigmatism:

With the rule astigmatism exists when the steeper meridian is vertical ± 30 degrees. This is corrected by placing a plus cylinder in vertical meridians or a minus cylinder in horizontal meridian.

Against the rule Astigmatism:

Against the rule astigmatism exists when the steeper meridian is horizontal ± 30 degrees. This is corrected by placing a plus cylinder in horizontal meridian or a minus cylinder in vertical meridian.

Oblique Astigmatism:

Oblique Astigmatism is one, where two meridians are not horizontal and vertical but still at right at right angles to each other.

Bi oblique astigmatism:

Bi oblique astigmatism is one, where the axis are not at right angles to each other, yet the difference is seen only in two meridians.

Irregular Astigmatism:

Irregular Astigmatism is characterized by an irregular change of multiple meridian which admit no geometrical analysis.

After surgical procedures, the principal meridians may have any axial orientation, although certain operations such as cataract surgery often Induce astigmatism with characteristic pattern.

The terms ‘suture induced’ and ‘surgically induced’ are frequently applied to studies on astigmatism. Suture induced astigmatism is the difference in astigmatism between the pre-operative and post operative measurement with the sutures still in place. The magnitude and variation with time may be significant because of

varying suture tension, difference in suture materials and other factors. Surgically induced astigmatism is the difference between pre-operative and post operative values after all sutures have been released or removed. This value is a more accurate reflection of the actual amount of astigmatism produced by the surgical procedures. Suture induced astigmatism arises from suture tension, tissue oedeme, and the underlying surgically induced astigmatism. Surgically induced arises primarily from the incision, its realignment and wound healing.

KERATOMETRY

Keratometry measures the radius of anterior corneal curvature over central cornea approximately 3mm in diameter although this value may vary with different instruments.

PRINCIPLES OF KERATOMETER:

Keratometry (measurement of the curvature of the anterior corneal surface) makes use of the first purkinje image. The corneal surface acts as a convex mirror, so that the size of the image produced varies with the curvature, the greater the curvature of the comea, smaller is the image size. Therefore from the size of the image formed by the anterior surface of cornea, the radius of curvature of comea can be deduced.

The instrument will read off the curvature in radius and in some instruments (Bausch and Lomb) gives the results in dioptres which must be converted to mm of radius by the use of a table. Usually the Keratometers are calibrated both for radius of curvature and corresponding dioptres. The range of Keratometer is 36 to 52D (6.5 to 9.38mm). Its lower limit can be extended upto 38D (5.6mm) and upper limit upto 61D (10.9mm) by interposing a lens of –1.0D and +1.25D respectively in front of the objective of the telescope.

Keratometer is designed to measure image size which is converted into radius of curvature by the optics of the instrument. The motion of the eye, presents a problem which is obviated by doubling the image and future helped by magnification. The image is magnified 1.304 times by the objective and magnified finally to 6.196 times by eye pieces.

TYPES OF KERATOMETERS:

The Keratometers are essentially of two types, either with a constant object size and variable image size (eg. Bausch and Lomb) or with variable object size and constant image size (eg. Javal – Shiotz)

There are many Keratometers having the same principle like, Helmholtz Keratometer Javal – Schiotz Keratometer, Bausch and Lomb Keratometer, Terry Keratometer5. Haeg Streit Keratometer. In this study **Bausch and Lomb** Keratometer was used.

Procedure of Keratometry:

The instrument is first calibrated. The patient is seated in front of the instrument with chin in the chin rest and head against the head rest. The eye which is not examined is covered with occluder. Then the chin is elevated. Then the chin is elevated or lowered till the patient's pupil and projective knob are at same level. The mire is focused so that the central image is no longer doubled. To measure the curvature in

horizontal meridian the plus signs of the central and left images are superimposed using the horizontal measuring control and reading is noted. To measure curvature in vertical meridian, the minus signs of the central and upper images are coincided with the help of vertical measuring control and readings are noted. In the presence of oblique astigmatism, the two plus signs will not be aligned and the entire instrument has to be rotated till the two plus signs are aligned corneal radius of power is measured in this meridian and in the meridian 90 to it.

COMPUTERIZED ANALYSIS OF CORNEAL TOPOGRAPHY

Corneal topography can be studied by computerized analysis of the image reflected from the corneal surface. The image is analysed at thousands of points and even minor variations in curvature can be detected. Information is obtained from larger area of corneal surface, unlike in Keratometry which obtains reading from only central zone. Corneal topography is useful in measurement of corneal astigmatism, contact lens fitting, refractive surgery and early diagnosis and monitoring of Keratoconus. Many patterns of corneal astigmatism are immediately apparent from the computerized image which are not revealed by refraction keratomtery.

A placido's disc is projected onto a 5 or 6mm diameter area of cornea and the reflection is converted into a digital image. Where the cornea is steeper, the reflected rings lie close together. Computer analysis produces a colour coded map of the corneal surface in which locations that have the same diopteric power are indicated by the same colour.

I. Numerical Power Plots – In numerical power plots the corneal curvature of specific areas is shown in dioptre values. The data is displayed in 10 concentric circular zones with 1mm interval.

II. **Keratometric view** – depicts the Keratometry reading in 2 principal meridian (K1 and K2) in 3 different zones simultaneously.

III. Photo Keratoscopic view – depicts the black and white photograph of the placido rings captured by video camera. This view helps in confirming the proper patient fixation.

IV. Profile View – shows the graphical plotting along x and y axis of the steepest and flattest meridian of the cornea and the difference between the two in dioptres.

V. Colour Coded Topographic Map

1. Colour Codes:
    - Hot colours – Red and its various hues represents the steep portion of the cornea.
    - Cool colours – Blue and its various hues represent the flat portions of the cornea.
2. Scale used:
    - Absolute scales have fixed end points and each individual colour always represents specific diopteric power interval. Most normal corneas remain within the yellow green spectrum of scale. Relative or normalized scales vary depending on the diopteric range of the individual cornea.

GUIDELINES FOR CALCULATION OF SURGICALLY INDUCED ASTIGMATISM

In this study vector method of astigmatism calculation was used. This was described by '**Stokes'** in 1846. In order to determine the amount of astigmatism produced by surgical procedure consider the example of a patient who has Keratometric reading of 44D axis 90 and 42D axis 180 (corrected with a + 2.0D Cyl. Axis 90) before surgery and 42D axis 90 and 44D axis 180 (corrected with + 2.0D Cyl. Axis 180) following surgery. In this case the amount of astigmatism (2D) might appear unchanged by surgery, if calculated in the usual manner and it might be concluded that no significant change in corneal curvature was produced by the surgery. In order to adequately evaluate the effect of a surgical procedure, in the corneal shape, not only the magnitude but also the axis of the major meridians must be considered. Similar considerations are employed in optics when one desires to combine two cylinders at different axes. Cylinders are vector quantities, possessing both magnitude and direction.

This is the method of calculation for the case just given. Here the (K1) initial vector (I) is +2D axis 90, and final vector (K3) (F) is +2D axis 180. In order to determine the change in corneal shape actually brought about in passing from the initial to the final curvature, it must be

determined what vector produced by the surgery (S) when added to initial vector (I) gives the final added ‘F’. This can be done graphically by trigonometric calculation. In our hypothetical example, the actual astigmatism induced was 4D at an axis of 180. Such calculation of vector corrected astignmatism are the preferred method for determining the effect of a surgical procedure upon corneal curvature as classic descriptions may be misleading.

FACTORS INFLUENCING POST OPERATIVE ASTIGMATISM FOLLOWING CATARACT SURGERY

A) PRE-OPERATIVE FACTORS:

Since the incidence of surgically induced astigmatism is low with the use of nylon sutures, the final astigmatic error depends in large part on the pre existing astigmatism. Low degrees of physiological astigmatism are common. There is a tendency for WTR astigmatism to predominate in youth and ATR astigmatism in elderly. There may be preexisting corneal astigmatism due to undetected keratoconus, corneal scarring corneal thinning, etc. One school of thought has been that it is best to leave the patient with an astigmatic error similar to the pre-operative error, since the patient is used to a certain spatial image determined in part by the astigmatic correction. Troutman recommended leaving the cornea with upto 1.5D of WTR astigmatism to enhance contact lens fitting and Huber recommended a similar amount to provide an increased depth of focus for near vision. Other reports claim that pre-operative astigmatism can be corrected during cataract surgery by varying the suture material, location of incision, depth of bite or by selective suture removal. For example, absorbable sutures with more anterior incision might be used in patient with pre-operative with the rule astigmatism.

B) INTRA OPERATIVE FACTORS

a) Cautery:

The long term effects of cautery may give rise to unacceptable levels of post operative astigmatism by (i) heat induced scleral shrinkage (ii) closure of capillaries & small vessels which affect the wound healing process. Hence cautery should be used sparingly during cataract surgery.

b) Incision Characteristics:

(i) Location: In conjunction with the type of suture used, the location of cataract incision can affect post operative astigmatism. More anterior incisions induce more astigmatism. The more anteriorly the incision is placed, greater the effect a given manipulation will have on the central corneal curvature.

Recently the concept of ‘astigmatic neutral zone’ has been introduced, wherein the presence of an astigmatism neutral funnel shaped zone has been hypotherized wound placed entirely within the confines of the funnel have negligible affect on post operative astigmatism.

Cravy observed that a lateral approach for ECCE (8.5 to 9.5mm) produced significantly less astigmatism than situated superiorly. This difference was attributed to the distractive influence of eyelid blinking

on superior wounds. Anders and colleagues noted significantly more astigmatism 8 months post operatively with superior scleral and limbal incisions than with temporal scleral and Limbal incisions.

Knowing that the cornea ultimately flattens along the meridian of the cataract incision, the surgeon can place the incision on the steep meridian of preexisting astigmatism.

(ii) Length: Lindstrom showed in a study that shorter incisions (0.5mm) produced significantly less astigmatism than longer incisions (10-11 mm). The incisional chord length of ECCE is generally 10 to11 mm, with phaeoemulsification varies from 3mm with foldable IOL, to 5 to 7mm to introduce rigid PCIOL.

Numerous studies have demonstrated that smaller incisions induce less initial WTR astigmatism and achieve stability faster than do larger incisions. There is gradual ATR astigmatism drift even with small incisions.

(iii) Shape and Cross sectional profile:

The configuration of the incision will influence wound stability and eventual against the wound drift.

Singer, introduced ‘frown’ incision. The incision is curved, the arc length 6mm or 7mm with apex of Frown 1.5mm posterior to clear cornea. Frown incision induces less surgical astigmatism compared with

standard scleral pocket incision. The incision has high degree of stability. Although modest degree of induced astigmatism results, minimal change occurs in actual amount of astigmatism induced. This incision is considered decay resistant. A straight or frown shaped incision induces less against the wound astigmatism change than the traditional curved incision parallel to limbus.

There is great emphasis on the horizontal aspect of wound profile, creating a scleral pocket or flap to provide a greater surface area for wound healing and realignment and learning the effect on the central corneal curvature by placing the sutures more posteriorly.

C) Suture Characteristics:

Of all the factor involved in producing astigmatism following cataract surgery, sutures have received the most attention.

(i) Suture Length: Suture produces a zone of compression that equals the length of the suture. Long sutures placed close to each other create significant tissue compression leading to WTR astigmatism. Widely separated suture on the other hand, permits wound slippage and cause ATR astigmatism. Sutures that are separated by a distance that equals their length causes minimal astigmatic change sutures 1.5mm long are optimal for cataract surgery, with the length of the bites equal on each side of the reaction.

(ii) Suture Tightness: Loose sutures, permits wound edge separation and this leads to ATR astigmatism. Tight sutures causes wound compression and WTR astigmatism. Typing sutures with the A.C. not fully pressurised produces excess WTR astigmatism.

(iii) Suture Depth: Sutures that are too superficial, tend to cut through and permits Wound edge slippage leading to ATR astigmatism. Fine sutures for eg 10-0 nylon are ideally placed at 90% depth. Sutures that are less fine, for eg. 8.0 silk, are placed half thickness depth. Thick suture if placed deep, can erode through due to necrosis of underlying tissue. The two lips of the wound should have the suture at the same depth for optimal apposition.

(iv) Suture Materials: Absorbable sutures cause premature or variable relaxation of the wound and tend to produce a surgically induced ATR astigmatism, although the suture induced astigmatism is initially WTR during the early post operative period. They are hence not suitable for closure in cataract surgery.

Of the non absorbable suture, large incisions closed with interrupted silk sutures demonstrated a shift form WTR to ATR astigmatism within 6 to 24 weeks, due to biodegradation. Nylon, mersilene, polypropylene or steel wire sutures maintain the zone of compression throughout the wound healing phase and are better

materials for wound closure polypropylene (prolene) and polyester (mersilene) sutures evidenced no hydrolysis over a 6 years period but the elasticity of poly propylene produced ATR shift.

The elasticity of nylon allows the suture to partially accommodate the wound edema and minimize subsequent changes in corneal curvature. The use of nylon sutures results in a slow drift to ATR astigmatism, and at 2 years post operatively there is a rapid ATR astigmatism change as a result of spontaneous rupture of the sutures. Suture induced astigmatism persists until, nylon suture is cut or until it hydrolyses which can take 2 years.

(v) Suture Orientation: Interrupted sutures should always be oriented radially. Non radial sutures cause lateral displacement of lips and hence leads to astigmatism.

The horizontal (tangential) closure induces less astigmatism than radial sutures. The horizontal closure is stable to decay upto 6-12 months. Horizontal suture closure produces minimal initial induced astigmatism and long term stability The vector forces of a radial suture preferentially affect tissue and thus corneal curvature along the axis of the suture. The advantage of horizontal suture closure is that the horizontal vector forces have much less effect on the cornea, hence less induced astigmatism.

(vi) Suture Techniques: Suture should be equidistantly apart, inserted to same depth, radial as possible and tied with same degree of tension each bite should be 0.5 to 1 mm length. The number of sutures depends on the material and length of the incision.

A technique involves making several radial marks with a fine tooth pick dipped in sterile methylene blue. The edges of the wound can be accurately aligned by suturing the blue stained edges together. The ideal depth of larger (7-0 or 8-0) suture placement is the middle third of the wound margins. A 10-0 superficial suture may slough out soon and cause posterior slippage of the wound. A too deeply placed suture may reach the anterior chamber and provide a path of escape of aqueous. Necrosis of the deep layers of the wound may results from crushing effect of the suture. Deep necrosis of wound does not result from 10-0 nylon.

If suture is placed at different depths of the two sides of the wound, apposition suffers. If the length of the bite on both sides is unequal, wrinkling may occur when the suture is tied.

The sutures must be tied sufficiently to unite the Wound edges but not so tight that necrosis and posterior gaping occurs. Excessive wrinkling of the cornea will be apparent if the suture is tied too tightly. Visualization of the wound edge is important when using fine sutures

because it is difficult to feel the proper degree of tightness of the knot. In this instance, it is wise to repressurise the anterior chamber before the sutures are tied. It is best to tie the knots on the scleral side of the incision, because the conjunctional flap is thicker here than at its anterior edge.

SPECIAL SUTURE TECHNIQUES:

A variety of continuous suture have been described. Using 10-0 monofilament nylon.

1. Shoe Lace Suture:

A scleral bite is taken at one end of the incision. Radial bites are taken until the opposite end is reached. The suturing is then reversed and continued to the starting point where the last bite passes through the corneal edge of the incision. After the loops are tightened, the suture ends are tied in the groove of the incisions.

2. Troutman suture:

A suture is cut in half, one portion is tied at 9.00 position from which it is continued nearly to 12'O clock. The other half is anchored at 2.30 and continued nearly to 12'O clock. The two halves are tied to each other at 12'O clock.

3. Continuous Interlocking Sutures:

This is similar to over and over suture except that each suture bite is locked.

The continuous portion should be closer to the cornea than to the scleral because this is the shortest circumferences. If placed on the scleral side of the wound it would loosen if slippage to corneal side occurs.

Except for the continuous locking suture, none of the suture bites is locked in these techniques.

d) Intra Operative Keratometry:

Intra operative keratometry guides during surgery, about the state of corneal curvature, or if it is possible to apply sutures in such a way that the corneal curvature becomes spherical.

There are many types of operating keratometers, Eg., Terry's keratometer is attached to the operating microscope. Using an operative keratometer, the ring of light reflected from the center of cornea is noted. If the reflection is round, there is no astigmatism. If reflection is oval, it can be made round either by loosening or removing a suture on the smaller side of oval or by applying suture on the longer side of oval, there by reducing post operative suture induced astigmatism. Intra

ocular pressure is an important variable in the accuracy of intra operative keratometry.

e) Intra Ocular Pressure:

Securing the wound in a soft eye has been postulated to result in greater induced post operative astigmatism, since greater tension is placed on the suture after the IOP increases to the normal range in the post operative period. Tying the suture at physiological IOP obviates this defect.

POST OPERATIVE FACTORS:

1. Post operative corticosteroids:

Intensive and prolonged use of corticosteroids cause decreased corneal wound tensile strength owing to inhibition of fibroblastic activity in stroma. Prolonged use of corticosteroids may cause greater wound slippage to help treat pre-existing WTR astigmatism.

Likewise, a short course of post operative corticosteroids helps to minimize astigmatic decay from a superior scleral pocket incision in a patient who has pre operative ATR astigmatism.

2. Suture Removal:

Selective removal of interrupted sutures in the axis of steepest curvature has proven utility in reducing post operative WTR astigmatism. A single tight suture is recognized by the axis of plus

cylinder and axis of higher Keratometric measurement Selective suture removal can be done 8 to 10 weeks post operatively if more than 3D of WTR astigmatism was present 3 to 5 weeks after surgery unless there was significant pre-existing WTR astigmatism.

3. IOL :

Lens tilt may be a possible cause of post surgical astigmatism. Significant tilting is required to induce clinically significant cylinder. A 20-D IOL must be inclined 10 degrees from the vertical plane to cause 1 Dioptre of cylinder.

MEASURES TO REDUCE POST OPERATIVE ASTIGMATISM

1. Intra operative measures :

1. Using a small, linear or frown shaped incision placed 2-3 mm from limbus .
2. Placing the incision on the steeper meridian of pre existing astigmatism.
3. Using Intra operative Keratometry
4. Limbal relaxing incisions – can be incorporated with cataract surgery.
5. Astigmatic Keratotomy – can be combined with cataract surgery or done post operatively.
6. Toric IOL.

2. Post operative measures :

Selective suture removal in the steeper meridian.

OBSERVATIONS

100 cases of uncomplicated cataract were taken up for the study. 50 patients underwent ECCE with PCIOL and 50 patients underwent SICS with PCIOL .

AGE INCIDENCE :

The age of the patients ranged from 45 to 80 years.

SEX INCIDENCE :

Male – 38, Female – 62.

Laterality :

GROUP	**R.E**	**L.E**
ECCE	31	19
SICS	26	24
TOTAL	57	43

PHYSIOLOGICAL ASTIGMATISM

75 cases in this study had physiological astigmatism and 25 cases did not have astigmaitism. The astigmatism was WTR in 36 cases (48%) and ATR in 39 cases (52%) as shown in the table below :.

S.No	Type of Astigmatism	Number of cases	
		ECCE Group	SICS Group
1	No Astigmatism	10	15
2	With the Rule	24	12
3	Against the Rule	16	23

The pre operative astigmatism in these cases ranged from 0 – 1.5D**. (K1)**

S.No.	Astigmatism in Dioptres	Number of cases		Mean Preoperative Astigmatism
		ECCE Group	SICS Group	
1.	0 - 0.99 D	37	35	0.55 D
2.	1 - 2 D	13	15	

In this study a comparative analysis of post operative astigmatism was done between ECCE Group and SICS Group each having a sample size of 50.

The following table shows the magnitude of astigmatism in the two groups two weeks post operatively.

S.No.	Astigmatism in Dioptres	Number of cases	
		ECCE Group	SICS Group
1.	0 - 2 D	6	33
2.	2.1 - 3 D	26	13
3.	> 3 D	18	4

The table shows that astigmatism two weeks post operatively was > 2 Dioptres in 88% of cases in ECCE Group and 34% of cases in SICS Group.

Comparison of the magnitude of astigmatism in the two groups four weeks post operatively.

S.No.	Astigmatism in Dioptres	Number of cases	
		ECCE Group	SICS Group
1.	0 - 2 D	26	38
2.	2.1 - 3 D	15	11
3.	> 3 D	9	1

The table shows that astigmatism four weeks post operatively was > 2 Dioptres in 48% of cases in ECCE Group and 24% in SICS Group.

Comparison of the magnitude of astigmatism in the two groups six weeks post operatively (K3).

S.No.	Astigmatism in Dioptres	Number of cases	
		ECCE Group	SICS Group
1.	0 - 2 D	36	45
2.	2.1 - 3 D	10	5
3.	> 3 D	4	-

The table shows that astigmatism six weeks post operatively was > 2 Dioptres in 28% of cases in ECCE Group and 10% in SICS Group.

The type of astigmatism and mean vector astigmatism in the different types following ECCE with PCIOL is shown in the following table.

S. No.	Type of Astigmatism	No. Of Cases	Mean Vector astigmatism
1	With the Rule	29	1.71 D
2	Against the Rule	18	1.49 D
3	Oblique	3	2.33 D

The type of astigmatism and mean vector astigmatism in different types following SICS with PCIOL is shown in the following table.

S.No.	Type of Astigmatism	No. of Cases	Mean Vector astigmatism
1	With the Rule	30	0.98 D
2	Against the Rule	17	1.01D
3	Nil	3	_

Though the post operative incidence of WTR astigmatism was the same in both the groups, 3 cases in ECCE Group converted to Oblique astigmatism whereas 3 cases had Nil astigmatism in SICS Group.

The following table shows the comparison of the number of cases with no astigmatism and WTR astigmatism before surgery converted to ATR and Oblique astigmatism post operatively.

S.No.	Group	No.of cases with Nil astigmatism and WTR astigmatism before surgery	No. of cases converted to ATR and Oblique astigmatism after surgery
1.	ECCE	34	11 (32.35%)
2.	SICS	27	7 (25%)

The following table shows the comparison of mean vector astigmatism in SICS group with two different Length of incisions.

S. No.	Length of incision in Millimeter	No. of cases	Mean vector astigmatism	'P' value
1	6.5 - 7.5 mm	34	0.65 D	< 0.001
2	7.6 - 8.5 mm	16	1.54 D	

The above table shows that the mean vector astigmatism is considerable lesser in the smaller incision group, 'P 'value being < 0.001 proves statistically that smaller incision induce lesser astigmatism.

The following table compares the mean vector astigmatism between the three shapes of incision used in SICS group.

S.No.	Shape of incision	Number of cases	Mean vector astigmatism
1.	Linear	32	1.12 D
2.	Frown	16	0.43 D
3.	Smile	2	2.12 D

This table shows that Frown incision induces lesser astigmatism and the curved, smile incision induces more astigmatism.

COMPARING THE MEAN VECTOR ASTIGMATISM

S.No.	Group	No. of cases	Mean vector astigmatism	'P' value
1.	ECCE	50	1.62 D	< 0.001
2.	SICS	50	0.93 D	

Comparing WTR cases

S.No.	Group	No. of cases	Mean vector astigmatism	'P' value
1.	ECCE	29	1.4914 D	< 0.038
2.	SICS	17	1.0147 D	

Comparing ATR / Oblique cases

S.No.	Group	No. of cases	Mean vector astigmatism	'P' value
1.	ECCE	21	1.7976 D	< 0.0001
2.	SICS	30	0.9750 D	

The above table show that the mean vector astigmatic value significantly increased in ECCE group when compared to SICS group. Among ATR cases it is significantly increased which is statistically proved.

It has been proved statistically that men vector astigmatic value in ECCE was found to be 1.62 ± 0.81 D and in SICS was 0.93 ± 0.56 D.

All these patients were followed at third month and keratometry reading was taken.

COMPARISON AT THE THIRD MONTH

The following table shows the magnitude of astigmatism at three months.

S.No	Astigmatism in Dioptres	No. of cases	
		ECCE	SICS
1.	0 – 2 D	46	47
2.	2.1 - 3 D	4	3
3.	> 3.0 D	-	-

The following table shows the type of astigmatism and mean astigmatism at three months in the ECCE group

S.No.	Type of Astigmatism	No. of cases	Mean astigmatism
1.	Against the Rule	17	1.09
2.	With the Rule	27	1.13
3.	Oblique	3	1.83
4.	Nil	3	-

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The following table shows the type of astigmatism and mean astigmatism at three months in the SICS group

S.No.	Type of Astigmatism	No. of cases	Mean astigmatism
1.	Against the Rule	29	0.89
2.	With the Rule	16	0.91
3.	Nil	5	-

The above table shows that there was less significant change in the magnitude and type of astigmatism after 3 months which was relatively equal to mean astigmatic value at 6 weeks in SICS group but in ECCE group the astigmatic value was found to be significantly reduced by 0.53 D (1.62 – 1.09). It was also found that 3 cases had Nil astigmatism in ECCE group and 5 in SICS group post operatively at 3 months.

DISCUSSION

The preoperative incidence of physiological astigmatism in this study was 75% which is higher than 42% by Niran Kari & Khanna (1968), 60% by Kapoor (1965) and 69% by Singh & Ghoel (1969). It is almost similar to 79% by Beasley (1971), 77% by Irina. S. Baraquet (2004) . it is less than 95% by Duke elder (1949), 93% by Riley. A. F. (2001), 100% by Woo. S. J. (2003).

The physiologic astigmatism was WTR in 36 cases (48%) and ATR in 39 cases (52%). The average preoperative astigmatism in this study was 0.55D, compared with other studies, 0.75 D by Beasley (1967); 0.5 – 0.75 D by Duke Elder (1970); 0.99 D by Bansal. R.K. (1992); 0.5 D by Sood. A. (2003); 0.5D by Gohale Nikhil.S. (2005).

The mean surgically induced astigmatism two weeks post operatively in ECCE group was 3.01 ± 0.84D, lesser than 5.76 D by Bansal .R.K. (1992); 4.6 D by Sood.A. (2003) and similar to 3.47 D by L.Zheng (1997). It was 2.34 ± 0.83D at four weeks greater than 1.44 D by Talamo (1991) and similar to 2.7 D by Sood.A. (2003), 2.99 D by L.Zheng (1997). At six weeks it was 1.83 ± 0.85 D similar to 1.91 D by L.Zheng (1997), 1.7 D by Sood.A. (2003).

The mean surgically induced astigmatism two weeks post operatively in SICS group was 2.10 ± 0.75 D similar to 2.43 D by Steinert (1991), higher than 1.01 D by Zhang .X. (2002). At four weeks it was 1.68 ± 0.72 D which was higher than 0.62D by Zhang .X. but similar to 1.44 D by Steinert (1991). At six weeks it was 1.32 ± 0.69 D higher than 1.03 D by Steinert (1991).

Vector calculated astigmatism was the preferred method for determining the effects of a surgical procedure upon corneal curvature, because the amount of preoperative astigmatism should be taken into account at final astigmatism. In this study the mean vector astigmatism after ECCE was 1.62 ± 0.81 D and after SICS was 0.93 ± 0.56 D, 'P' value being < 0.001 which is statistically significant showing that astigmatism was vector significantly lower in scleral tunnel group than in ECCE. This was supported by study done by George. R. et.al wherein the mean vector astigmatism was 1.77 D for ECCE group and 1.17 D for SICS group. Many studies have shown that the surgically induced astigmatism is lesser in the scleral tunnel group and supports our study, 0.67 D by Zviaburgansky et.al (2002), 0.97D by Haubrich.J. et.al. (1996), 1.28 D by Ghokale.N.S. et.al (2005).

In a cross sectional study being done in this study group among post operative vector astigmatism of WTR and ATR cases in two types of surgery, showed that the mean vector astigmatism among WTR cases were significantly lower that that in ATR cases in both types of surgery.

In this study comparison of two different length of incisions was done in the SICS group. The mean vector astigmatism was found to be significantly lower in the smaller incision group, 'P' value being < 0.001, statistically proving that the smaller incision produces lesser astigmatism supported by the study by Lindstrom, Gill and Sanders, Armeniades et.al (1990), Ghokale Nikhil. S. (2005) and a study by Burgansky. et.al. (2005). In this study comparison of three shapes of incision, smile, Frown, Linear was made in SICS group and our inference was that the mean vector astigmatism was significantly lower in the frown group and higher in the smile group. This was supported by the study conducted by Junsuka Akura et.al. (2000), Paul S. Koch(1991), Armeniades et.al. (1990), Robert Sinskey et.al.. (1994) and by Singer study. 3 patients with preoperative WTR astigmatism had Nil astigmatism postoperatively using frown incision, proving that incision placed in the steeper meridian reduces astigmatism as studied by Masket et.al. (1989).

Though the incidence of WTR astigmatism was almost similar in both the groups, 3 cases showed conversion to Oblique astigmatism from Nil astigmatism in the ECCE group. The cases were followed post operatively and Keratometry was done a third month. Mean astigmatic value was found to be reduced in ECCE group from 1.62 D to 1.09 D which was statistically significant. This was compared with the study conducted by Talamo et.al.(1991) and L.Zheng (1997) on effect of post operative astigmatism, that there would be some amount of astigmatic decay every month after ECCE. But in SICS group there was less significant decay.

SUMMARY

One hundred cases of uncomplicated cataract with clear cornea and V/A ranging from PLPR + to 6/36 underwent cataract surgery by two methods, 1) ECCE with PCIOL implantation 2) SICS with PCIOL implantation, each having a sample size of 50. In SICS group, surgery was done using 3 shapes of incisions. Linear in 32 patients, Frown in 16 patients and Smile in 2 patients. The incision length in SICS group varied from 6.5 – 8.5mm. The patients were divided into two groups based on the length of incision, 6.5 - 7.5mm and 7.6 – 8.5 mm. Preoperatively keratometry was done in all these patients and post operatively patient was followed up at 2 weeks, 4 weeks, 6 weeks and at 3 months.

This study was done to evaluate the post operative astigmatism by keratormetry in 100 cases of cataract surgery by the two surgical techniques, to find out which surgery produced less post operative astigmatism. This study also analyse if the use of smaller incision in SICS group produced less post operative astigmatism and to find out the shape of incision which produced lesser post operative astigmatism.

It was found in this study that the SICS with PCIOL, produced less degree of post operative astigmatism and in the same group, use of smaller incision and using frown incision produced lesser post operative

astigmatism. It was also found that placing the incision on the steeper meridian, reduces the preexisting astigmatism.

This study also revealed that there was greater shift to ATR and Oblique astigmatism in ECCE with PCIOL group, whereas in SICS with PCIOL group shift was less. It was also found that 0.53 D of astigmatic decay occurred in ECCE group at 3rd month but there was no such decay in SICS group.

CONCLUSION

- The length, location, shape of incision, suturing technique and number of sutures have effect on post operative astigmatism.
- Longer incision, curvilinear to limbus and suturing produces greater post operative astigmatism and a drift towards ATR/Oblique astigmatism as in ECCE.
- Small, posteriorly placed incision produces less post operative astigmatism.
- Frown shaped incision in SICS produces less post operative astigmatism.
- It is inferred and concluded that SICS using frown incision could be the preferred mode of cataract surgery resulting in minimal post operative astigmatism.

PROFORMA FOR POST OPERATIVE ASTIGMATISM IN SMALL INCISION CATARACT SURGERY AND EXTRACAPSULAR CATARACT EXTRACTION WITH PCIOL IMPLANTATION

Name : **Age/Sex:** **I.P.No.**

Date of surgery :

Diagnosis : RE : **LE :**

Preoperative V/A.: RE: **LE:**

Preoperative 'K1' reading RE/LE :

a) Dioptric Power : **H:** **V:**

b) Radius of curvature **H:** **V:**

c) Amount of astigmatism :

d) Type of astigmatism :

Preoperative : I.O.P.:

SLE :

Fundus:

Type of surgery :

Length of incision :

Shape of incision :

Suture material used:

Number of sutures :

Post operative 'K' reading RE/LE (2 weeks) :

a) Dioptric power : **H:** **V:**

b) Radius of curvature **H :** **V:**

c) Amount of astigmatism:

d) Type of astigmatism :

Post operative 'K' reading RE/LE (4 weeks) :

a) Dioptric power : **H:** **V:**

b) Radius of curvature **H :** **V:**

c) Amount of astigmatism:

d) Type of astigmatism :

Post operative 'K3' reading RE/LE (6 weeks) :

a) Dioptric power : **H:** **V:**

b) Radius of curvature **H :** **V:**

c) Amount of astigmatism:

d) Type of astigmatism :

Final Vector astigmatism at 6 weeks :

(K2 = K3-K1)

Subjective correction :

Post operative V/A RE/LE :

Fundus examination of the operated eye:

Post operative ‘K’ reading RE/LE (at 3 months) :

a) Dioptric power : H: V:

b) Radius of curvature H : V:

c) Amount of astigmatism:

d) Type of astigmatism :

KEY WORDS

ECCE	:	Extracapsular Cataract Extraction
SICS	:	Small incision Cataract Surgery
AC	:	Anteior Chamber
CCC	:	Continuous Curvilinear Capsulorhexis
PCIOL	:	Posterior Chamber Intra Ocular Lens
WTR	:	With the Rule Astigmatism
ATR	:	Against the Rule Astigmatism

INDEX TO MASTER CHART

1. H.M	:	Hand Movements
2. PL	:	Perception of Light
3. PR	:	Projection of Light
4. V/A	:	Visual Acuity
5. H	:	Horizontal Meridian
6. V	:	Vertical Meridian
7. W	:	With the Rule Astigmatism
8. A	:	Against the Rule Astigmatism
9. O	:	Oblique Astigmatism
10.N	:	No Astigmatism